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ABSTRACT

Using J. Dewey's "reconstruction of experience" concept of revision, a study employed ethnographic methods to investigate the effects of computer assisted writing instruction on students' revising processes. Primary subjects, eight sixth-graders, completed a structured revision task on their compositions, with varying degrees of computer interaction. Data sources included fieldnotes, interviews, audiotapes, videotapes, and writing samples. Retrospective interviews were conducted with the two primary case study writers, and their experiences were related to the revision patterns of 61 students in four classes. Statistics showed that students using computers to revise their compositions wrote longer papers and received slightly higher holistic scores. However, findings revealed that the most striking differences had little to do with computers--class means corresponded dramatically with instructional emphasis. Results suggested that students revised according to a construct of "good writing" that could be linked to three instructional emphases: fluency, word choice, and mechanics. Results also indicated that revision of fluency, word choice, and mechanics could be taught. Thus, the results suggest that the revision process is driven by instructional emphasis, not computer interaction. (Interviews and scoring of the two primary case study writers and statistical tables are included.) (JD)

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THE ROLE OF INSTRUCTION IN REVISING WITH COMPUTERS:

Forming a Construct for "Good Writing"

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Abstract

During 1984-85, the researcher collaborated with a team of elementary and secondary teachers on field studies of writing with computers. All teachers had participated in advanced training through the university's National Writing Project site. The research design was ethnographic, with data including fieldnotes, interviews, audiotapes, videotapes, and writing samples. Eight sixth graders served as subjects in case studies of the composing process.

This report analyzes the results of a structured revision task completed by 61 sixth graders either on the computer or with hand writing tools. It begins by discussing retrospective interviews with the two primary case study writers, and then relates their experiences to the revision patterns in the four classes. The results suggest that students revised according to a personal construct for "good writing" which can be linked directly to the instructional emphases of their teachers as recorded in the fieldnotes.

THE ROLE OF INSTRUCTION IN REVISING WITH COMPUTERS:

Forming a Construct for "Good Writing"

Insights from case studies of student writers can often be enhanced by ethnographic studies of their classrooms. A growing body of research considers not merely what students write, but also what they think about writing decisions and how they learned to think that way.

Dewey (1916/1967) defines education as the continuous reconstruction of experience (p. 80). Similarly, Britton (1970) speaks of a world representation (p. 15) distilled from experience which shapes the learner's view of new experiences and is itself reshaped. In much the same way, a writer's representation of "good writing" shapes the revision process.

Studies of revision show that such representations differ markedly. Sommers (1980) found that skilled adults saw revision as a "recursive" process of making meaning and resolving dissonance; her college freshmen saw it as a final polishing of mechanics and vocabulary. Other studies (Bridwell,1979; Calkins, 1980; Flower, Hayes, Carey, Schriver, & Stratman, 1986; Scardamalia and Bereiter, 1983) have reported contrasting approaches to revision among subjects ranging from primary children to professional writers.

The computer has potential both in facilitating and in studying revision. As Madigan (1984) explained, new tools inevitably shape a writer by making some tasks easier than others; could word processing promote certain kinds of revision? Daiute (1985) found that computerized prompting helped younger

writers question their own texts. Bridwell, Sirc, and Brooke (1985) used keystroke-recording software to interview college writers about the revisions they had made at the computer.

One weakness of case study research is that writers must generally work outside their usual environment. (Murray, 1983, felt like a "laboratory rat" taping an oral protocol.) Current pedagogy challenges the validity of isolating writers for research. Thus the National Writing Project (NWP) stresses the social aspects of writing for an audience of peers and trusted adults.

Ethnographic methods may be best-suited to a process model of language learning (Harste, Woodward, & Burke, 1984). Using the principles of McCall and Simmons (1969) and L. Smith (1979), researchers can watch children build their own concepts of "good writing" through classroom interaction. Mohr (1984) and Perl (1983), both NWP leaders, have applied interviewing, participant-observation, and triangulation of data to writing classes.

Several investigations of computers and writing have drawn on classroom ethnography: Mehan (1985); Michaels, Watson-Gegeo, & Cazden (1985); and Sheingold, Hawkins, and Char (1984). Their findings suggest that computers may enhance social learning, reflective thinking, and revision--in the hands of some teachers.

Methods

The present study looks at the classroom environments created when teachers who are writing specialists have access to computers. In 1984, twelve National Writing Project-trained teachers were invited to participate in a summer institute on

writing with computers, followed by collaborative research.

During 1984-85, our focus of research was the sixth grade. Two NWP-trained teachers had regular access to computers, one in a heterogeneous classroom, the other in a gifted resource center. Two more NWP teachers did not attend the computer institute but pursued other advanced study in writing; they provided comparison settings for pen and paper composing, one in a heterogeneous classroom, the other in a gifted program.

From these classes, eight sixth graders agreed to help us as case-study writers. During nine months of informal classroom visits and four structured interviews, they shared their folders of drafts and their experiences writing a variety of papers. Students wrote in their usual classroom or lab settings, and the teachers helped me design all tasks required for the research.

Our goal was to understand revision through Dewey's "reconstruction of experience." Students who revise only superficially seem stuck in the bondage of their own first drafts. As F. Smith (1982) explains, they must learn to reflect on what they see, recognize the gap between their meaning and their texts, and reconstruct the draft accordingly. What model of "good writing" would our case study children bring to the experience of reading and revising their own texts?

This report deals with just one of the texts sixth graders produced during the year. Unlike most, this was not an original paper, but a revision of a story containing planted flaws. To develop the task, the four teachers first inventoried the problems they expected students to revise, from "dull opening sentence" to "lack of . . . detail" to "homonym error." Next we

rewrote an actual student draft to contain the target flaws. The children then revised this story as a class assignment:

> This is story about Harry, a timid person who is easily scared. One night at midnight, Harry saw some shadows behind the treehouse in the park wich isn't far from the city bank. He couldn't here what they were saying, so he ran for the police because he thogt they might be bankrobbers but he stopped and said to himself, "wait I'll see what they are doing first," then he also said, "forget it, man, Im chicken," and ran for the police once more. When he got back with the police, he found out that his friends were waiting to surprise him. They really wanted it to be a surprise. Cause it was his brithday. Now the time was 1:05 A.M. the exact time he was born.

All 61 students in the four groups rewrote the same text in the same time (30 minutes). Pen and paper students received the story, typed double-spaced, to mark up and recopy on lined paper. Computer students called up the text on their monitors, revised, saved, and printed their versions. I observed that all four teachers gave highly consistent instructions. Each guided revision for content and form, asking, "What makes a good story?"

Interviews

The case study writers told me about their revisions of "Harry," including the false starts and the words set down and then rejected. Pen and paper writers saved their marked-up papers and made all changes with a single strikeout in pen. With

word processing, however, all in-process changes would vanish in electronic amnesia. Following the procedures of Bridwell, Sirc, and Brooke (1985), I commissioned software that records keystrokes and replays the composing session. COMPTRACE, based on the MILLIKEN WORD PROCESSOR,[1] proved very effective in interviews. As children watched the "instant replay," they could reconstruct the experience of writing and find the words to generalize about their own processes.

Scardamalia and Bereiter (1983) found that questions like "How do you decide what to write when you're given a writing assignment?" tend to elicit blank stares from young writers. Instead, they suggest talking students through specific tasks. COMPTRACE created the context for such questions:

--What did you think of this story when you first saw it?

--What was the first thing you changed? Why?

--How did you know that this [specific item] needed fixing?

--How do you feel about your version now?

The revised stories were later examined using a revision typology, error analysis, fluency count, and holistic scoring.

Revision Classification

Bridwell's typology (1979; adapted in Bridwell, Sirc, & Brooke, 1985) served to classify revisions by level (surface, word, intra-sentence, sentence, multi-sentence) and operation (such as addition, deletion, substitution). Like the interviews, this analysis was limited to the eight case studies, using keystroke records and marked drafts. I conferred with Bridwell on my interpretation of ambiguous cases and decision rules.

Error Analysis

All 61 revised stories were checked to see which planted flaws students detected, and which they improved or corrected. This analysis was based on Calkins (1980); Flower et al. (1986); Hull and Smith (1985); and Scardamalia and Bereiter (1983). Detect means replacing one dull word with another (ran to went) or changing a fragment to a different sentence error. Improve/Correct means repairing a flaw or rewriting the text to eliminate it. For each writer, "improve/correct" changes[3] were recorded as a percent of the following totals: mechanics = 12; wording = 10; fragments/ run-ons = 2; introduction/ conclusion = 2. Seven research-team teachers were trained to count items. Each paper was scored twice and I resolved the few discrepancies.

Fluency

An assistant counted words in each revision. While most papers stayed near the original 127 words, revisions ranged from 100 to 388 words.[3] Since both these atypical stories earned the top holistic score, fluency did not unduly affect quality ratings.

Holistic Scoring

All handwritten papers were first typed with word processing software and coded. Two members of the research team who did not participate in the error analysis then scored all the papers.

A 6-point rubric had been used for holistic scoring of a fall writing sample in grades six through eight.[4] Since all "Harry" papers were written by sixth graders and were based on the same draft, a 4-point rubric seemed adequate. The lowest score was reserved for the original "Harry" or for "revisions" that added as many flaws as they corrected. The top score showed

"good development of story" with "good editing of mechanical errors." The middle scores reflected a combination of skills.

Scoring followed White's (1985) procedures, with prototype anchor papers, discussion of difficult cases, and frequent checks for agreement. The consistency of unadjusted scores, excluding anchors and rereadings, was .74 (intraclass correlation).

Case Study Results

During the year, I watched students learn a language to talk about writing decisions and reconstruct writing experiences. The interviews supported the classroom environment of teacher conferences and peer response. Case study writers formed their own constructs for good writing, the personal sense of style applied to explain what they liked or disliked in a text.

These constructs for good writing are evident in the transcripts of student responses to the "Harry" task. The two central case study writers, a very talented girl ("Mary") and a very low-skilled boy ("Bob"), will serve as illustrations. Both Bob and Mary were members of the same class of 15 mixed-ability sixth graders who spent eight hours per week with a writing project-trained teacher. This focal class was a natural laboratory for studying how children learn to write when the computer is available on a daily basis as a writing tool, not as a curiosity or a game machine. Here is a view of that classroom:

> The language arts room serving sixth, seventh, and eighth graders in a small parochial school housed classes of 15 - 23 children--along with two manual typewriters and two Apple

II-e computers. The mechanical writing tools complemented the teacher's instructional style: the open classroom with a variety of learning centers. In her classroom, a computer was not a shiny chrome table in a roomful of Early American, but rather a new species of fern in a room already flourishing with greenery.

Mary

Mary was a fluent writer and an avid reader. Her California Achievement Test scores placed her in the 97th percentile in Language, the 92nd percentile in Reading (national norms). Her writing folder showed a willingness to draft and revise, often five or six times, before completing a piece to her satisfaction.

When Mary called up "Harry" on the computer, she first scrolled quickly through the file, and then began to edit. She fixed a few surface errors on the way, but spent most of her time revising style, content, and detail. Here is her 160-word story:

> Harry is a timid person who is easily frightened by little things. One breezy evening at midnight, Harry saw some dim shadows behind the creepy treehouse in the partk. The city bank is just around the corner from there. He couldn't exactly make out what they were saying, so he quickly started on his way to the police department. He thought it was mysterious and they might be bankrobbers but he suddenly stopped and said quietly to himself, "Wait I'll see what they are planning first," but then he added, "No I can't I would chicken out before I had a chance," and darted after the police once more. When he finally got back he dragged the police to where he had seen the robbers, but instead he

found his friends waiting to surprise him. He was baffled until they reminded him that it was his birthday. Because now the time was 1:05 A.M. the exact time he was born.

Interview

Mary discussed her revision effectively while viewing the replay. Asked about her first impressions of "Harry," she began in generalities: "Some of it was good, but . . . something was wrong." COMPTRACE showed that Mary had first changed thogt to thought, and she confirmed that the misspellings were obvious targets: "I just noticed that right away." Prompted to elaborate on her more global concerns, Mary added that the story was "sort of bad description," and the opening lines rambled and "carried on." The lead was, in fact, the next place she moved her cursor.

Her first attempt deleted the bland opening clause and added descriptive words: Harry is a timid person who is easily scared. One creepy night at midnight, Harry saw some dim shadows behind the treehouse in the part which. . . ." As she struggled with the opening scene, first it was a creepy midnight and an unsteady treehouse; then a moonlit midnight, and finally a breezy evening and a creepy treehouse. She commented, "I took out 'creepy' because I thought it would sound better by 'treehouse.'"

COMPTRACE shows that Mary revised for mechanics, detail, and sentence structure during several complete runs through the text. "I decided to read through it again and then I saw some more things to change," she explained.

For most revisions, she gave reasons suggesting a well-developed "problem representation" (Flower, et al, 1986). For

example, she changed doing to planning: "Well, 'doing' could be jumping up and down, but 'planning'--they're making plans to get in, so you're going to try and stop them." She wrote He couldn't exactly make out what they were saying instead of couldn't hear "because I think it sounded like he was straining to hear, but he couldn't." She added vivid verbs, darted and dragged, explaining that "The police would probably think it was a prank." Then she noticed a vague pronoun in dragged the police to where he had seen them, and substituted robbers, commenting, "Well, 'them' could also be the police." She added a stronger transition, explaining that Wait, I'll see what they're planning first made Harry sound "daring," so she needed a but when he was afraid to follow the strangers. She inserted, He was baffled until they reminded him that it was his birthday, because "You really wouldn't remember that it's your birthday if it's like 1:00 in the morning." She then deleted two short, redundant sentences because "He was surprised, you know . . . That was enough."

Mary's understanding of her own writing decisions is quite explicit. Yet even with my probing, she did not justify her revisions with textbook rules or terms. Instead, she gave a rhetorical diagnosis--she explained decisions in terms of speaker, subject, audience, or purpose. This mode of discourse was used consistently by the writing project teachers in this study to discuss student, as well as professional, writing.

Mary's own assessment of her final version was "pretty good." But if she could do it again, she would delete the whole lead up to One breezy evening. Her revision process shows a recursive appraisal including local and global issues, always

ready to discard the latest text for something better.

Scoring

Both raters gave Mary the top holistic score (two 4's on a 4-point scale) for improvement in content as well as form.

The error analysis (Table 1) shows that Mary handled the planted flaws skillfully. She eliminated 9 of the 12 mechanical errors, 4 by correction and 5 in rewriting. (She actually corrected some of the latter--wich, here--in process before rewriting.) She ignored the missing commas. Her 5 word changes (unusually high) improved 2 redundancies and 3 dull words. Mary was among the few writers who corrected both the fragment and the run-on, although she created a new fragment in the last sentence. She also added life to the introduction.

Insert Table 1 about here

Mary's revision process was also analyzed with Bridwell, Sirc and Brooke's (1985) typology, using the COMPTRACE records. The data show that she made just 5 changes at the surface level, 14 at the word level (mostly additions), 13 at the intrasentence level (half of them substitutions of phrases or clauses), and 4 at the sentence level. Her focus of attention on the word and intrasentence levels is a pattern Bridwell (1979, p. 113) found typical of competent twelfth grade writing.

What does "Harry" show about Mary's model of "good writing"? Most of her 27 word and intrasentence changes served to add detail. Throughout the year, her papers and interviews confirmed this love of description. Sometimes she crafted with precise,

vivid words (ran to darted); other times, she chose pretty but overused descriptors; here is an example of the latter from her last major paper of the year:

> Draft--Now Rosarina would brighten everyones day after it rains, and Aphrodite could see her daughter.
>
> Revision--Now Rosarina would brighten everyone's day after a horrible rain, and Aphrodite could again see her wonderful daughter, Rosarina.

Mary's comments on this text give a glimpse of her revision goals: "I like description. I added 2 adjectives to make it more descriptive." Mary had the skills and the self-awareness to revise at all levels. Her taste, however, was not yet that of a mature writer. Her personal construct of "good writing"--the ideal that guided her revisions--might be stated in this way:

"Good Writing Is Descriptive"

The computer supported Mary's progress toward this goal. At the keyboard, she could play with word level substitutions and intrasentence additions until she created a pleasing description.

Bob

Mary's classmate Bob presents a contrasting picture. With California Achievement Test scores in the 10th percentile in Reading and the 11th percentile in Language, Bob had experienced mainly failure and frustration in writing. It was his infatuation with computers, rather than a love of writing, that led him to participate enthusiastically in the case studies.

I watched as Bob worked with the "Harry" task on his screen. Unlike Mary, he directed most of his attention toward surface and

word level changes. His finished story was the same length as the original, 127 words, but incorporated 12 different changes:

> This is story about Harry, a wimpy person, who is easily scared. One dark gloomy night at 12:00am, Harry saw some shadows behind the the big tree in the park, wich isn't far from the city bank. He couldn't here what they were saying, so he ran for the police because he thoght they might be bankrobbers but he stopped and said to himself, "wait I'll see what they are doing first," then he also said, "forget it" and ran for the police once more. When he got back with the police, he found out that his friends were waiting to surprise him. They wished they could have surprised him because it was his brithday. Now the time was 1:05 A.M. the time he was born.

Interview

Asked what he thought of the original "Harry," Bob admitted, "Well, it wouldn't be a story that I would read, like, I mean I wouldn't go looking for it in a bookstore or anything. . . But it's not that bad, I mean I've seen worse stories." More specifically, he disliked "some of the words," citing timid because it "just kind of makes me sick." He changed it to wimpy.

He also objected to some of the sentences: "They stopped, I mean the sentences were too short. They should have made a run-on sentence for a couple of them." Some other sentences "should have periods. . . to break them up, 'cause you don't want big sentences but you also don't want about 20 sentences." Bob's comments suggest a concept of the sentence based on length rather

than on syntax, leading to what Flower et al. (1986) call "maxim-based revision." This rough maxim led Bob to correct the sentence fragment, but he was one of the few students who did not, in fact, insert any periods to break up the run-on.

Bob's revision process showed his usual struggle with spelling. While typing he had looked up to ask me how to spell "gloomy" (his screen showed gluemy). I referred him to the dictionary, and he succeeded in manipulating the cursor to correct it. Watching COMPTRACE, he commented that he didn't notice many spelling mistakes at first. As he saw other students working, he looked more closely at the text and saw the errors.

Bob tended to offer vague explanations of his writing decisions, unlike Mary's explicit diagnoses. I asked, "Why did you get rid of Man, Im chicken?" He replied, I just didn't like it. I think it was just too long." Again, I asked, "Instead of midnight you made it 12:00 a.m.--how come?" Bob hesitated:

> Um, I don't know, it just seemed like it was too long. . . 'Cause right here it said one night at midnight. I don't think that sounded too nice because you were using night two times. . . I put 'twelve a.m.' because it sounded different.

Here Bob started with a loose maxim, but when prompted by the replay and the interview, proposed an explicit redundancy rule.

Bob could also justify his sentence combining: They wished they could have surprised him because it was his brithday. The arrival of the police would have spoiled the plan for the surprise party, he explained, making it just a "wish." "I changed that sentence almost all the way," he added proudly.

Most often, however, Bob found revision frustrating:

Interviewer: "When you're reading through like this, what's going on in your head? What are you looking for?"

Bob: "I'm just trying to search. . . . You read through it and when you can't find anything you get furious. I feel like I'm just gonna punch, just punch a hole in the wall."

I: "Are you furious because you know there's something there and you can't see it?"

B: "Yeah. . . sometimes you'll read that word about 16 times--and then you finally find out that it's spelled wrong."

Bob's goal in revising "Harry" was simply to "fix up mistakes." When asked if something else might have been improved, however, he volunteered, "This wasn't too long of a story. I think he. . . should have wrote a little bit more instead of ending it so quickly." He could identify with the author's problem: "I know I do that a lot too, you know, I'll get tired of writing a story so I'll just kind of end it real quick."

How would he develop the tale? Bob suggested changing the main character's personality. "I might say that he didn't go to get the police because he was a scared person. He was kind of nosy." I responded, "So he wouldn't have been wimpy anymore, he would have been brave?" Bob agreed with a grin.

Scoring

Bob's "Harry" revision earned two 2's on a 4-point holistic scale, reflecting minimal improvement in content and only partial correction of mechanics.

The error analysis (Table 2) showed that he fixed just 2 of

12 planted surface errors and 1 of 10 dull or redundant words (midnight to 12:00 a.m.). He corrected the fragment but did not improve the run-on, the introduction, or the conclusion.

Insert Table 2 about here

When Bob's revision process is analyzed, the Bridwell typology confirms that he focused on the surface level, where 6 of his 12 changes occurred. In addition, he made 1 change at the word level, 3 at the intrasentence level, and 2 at the sentence level when he substituted and combined the short ending sentences.

Bob' performance suggests a typical, low-skilled pattern. Calkins (1980) called it refining rather than revising for meaning. Sommers (1980) and Bridwell (1979) saw it among older basic writers who focused on surface correctness but failed to improve either mechanics or overall quality.

Working independently--as he did in revising "Harry"--Bob's skills remained poor throughout the year. With support, however, he could work at a somewhat higher level. The gap in performance recalls Vygotsky's (1979 trans.) "zone of proximal development." In Bob's classroom, the critical support came from the computer, from peer resources, and from conferences with teacher or researcher. He was thus able to produce such creditable pieces as "Spy Hunter," a 450-word story he worked on for six weeks.

If Mary knew "good writing" by description, Bob seemed to know it by length. His maxim for correct sentences was based on length--not too short (fragment) and not too long (run-on). He deleted details if they made the lines "too long." Finally, he judged the merit of a story by its sparse development. Bob's

other revision concern was spelling. All his drafts showed a high percentage of changes attacking misspellings. Bob's personal construct for "good writing" might thus be stated:

"Good writing has the right length and spelling"

The computer reinforced Bob's representation of "good writing." The computer let him add and delete material easily, adjusting length without recopying a whole paper. It let him fix spelling errors neatly. It gave him the romance of a technological process along with the discipline of a written product.

Learning a Construct for "Good Writing"

In their revision strategies, Bob and Mary seem typical of low-skilled and high-skilled writers respectively. Yet their ability to reflect is not typical of sixth graders. Both could distance themselves from their own writing and speculate on how it might be changed. Even Bob could reconstruct a story in which Harry was no longer timid. How did they learn to do this?

To become a competent language user, a child must outgrow two immature ways of thinking: the egocentric assumption that the reader shares his or her world view, and the rigid, text-bound assumption that whatever appears on the page is fixed. Moffett (1968) sees this growth as a product of dialogue--between teacher and student, and also among the students themselves. The National Writing Project has encouraged teachers to build classroom environments which create such a dialogue. Instructional methods suggested in NWP institutes and observed in the four research classrooms include peer response, role playing, teacher modeling, and a shared metalanguage through which members

of the community talked and wrote about writing experiences. Supporting these values, computers facilitated changing texts as well as presenting them to an audience.

The "Harry" task was designed to compare revising with the computer and revising with pen and paper. Some statistically significant differences did emerge: computer students wrote longer papers and received slightly higher holistic scores.[5]

The most striking differences, however, had little to do with computers. In each of the sixth grade classes, writers handled the "Harry" task in quite distinct ways. Table 3 lists the four groups and displays means for the error analysis, for fluency (word count), and for holistic (quality) scores:

Insert Table 3 about here

Why did students in four classrooms perform so differently on this revision? The differences in class means correspond dramatically to different instructional emphases I had identified in the year's fieldnotes of classroom observation. The data suggest that each teacher had guided her students to <u>see</u> certain features of writing. These items leapt off the page when they saw "Harry." Each group tended to revise according to the construct of "good writing" formed in that classroom environment. The four groups revealed three distinct instructional emphases: fluency, word choice, and mechanics. Instructional emphases were analyzed using the General Linear Models (GLM) procedure of the Statistical Analysis System (SAS) with significance set at .05.

Fluency

The focal class, Ms. Quinn's mixed-ability computer students, wrote the longest papers. Class means for "Harry" showed strong holistic scores (5.8 on a 2 - 8 scale), high fluency (150.8 words), and fair editing skills (7.3 of 12 errors corrected). Although this class had the weakest scores on the September pretest, holistic scores and fluency on the revision task were second only to those in the gifted computer center.

The fieldnotes suggest a pattern of instruction that led to this kind of revision. Ms. Quinn urged writers to develop and experiment freely, putting expression before mechanics. Peer partners learned to coach, "Tell more about. . ." and "You need some better details." Students wrote regularly both by hand and by machine, so that most became fluent at the keyboard. They checked spelling, often working with a dictionary or thesaurus alongside the computer. Yet Ms. Quinn did not spend much class time on mechanics. Students rarely produced mechanically perfect papers by the final printout and their teacher seldom commented on the remaining errors. She regarded surface correctness as a developmental goal, not a requirement for acceptable daily work.

Both Bob and Mary were members of this class. Much as their revision skills differed, both children had formed models of "good writing" related to fluency or development. Mary looked for descriptive detail, while Bob simply looked for length. The instructional emphasis in Ms. Quinn's class is thus identified as fluency. Using the pretest as a covariant, this group differed significantly from the others in length of products: $F(2,58)=$

11.47, $p < .05$.

Word Choice

The mixed-ability pen and paper group and the gifted computer group showed the most revision of dull or redundant language. Of 10 target words, students improved or rewrote 2.9 (mixed) and 4.0 (gifted), in contrast to about 2 words per student elsewhere. The two groups were linked instructionally. Both teachers worked in the same school and often planned together. The gifted center, which met just one day per week, drew two case study children from the mixed-ability class.

The fieldnotes show how these teachers emphasized word choice. In the gifted program, Ms. Zeller contrasted "wimpy words" with "vitamin verbs." In the regular pen and paper class, Ms. Gill often read aloud sentences with overused words in a bland, bored voice, asking students to brainstorm better choices.

This lesson was cited by a case study writer who had revised "Harry" at the computer in the gifted center. When asked why he changed ran to raced, Josh explained,

> Well, I was trying to put some more action into it. You know [scowl] ran. "The boy ran down the street." [exaggerated, sing-song intonation]. Now, "The boy jetted down the street!" [enthusiastic tone], as Ms. Gill would say.

Josh replaced many such words: creepy shadows for some shadows, stumbled for stepped, tip-toed for moved, noticed for saw.

Word choice was identified as the instructional emphasis for both Ms. Gill's and Ms. Zeller's groups.[6] Using the pretest as a covariant, these groups differed significantly from the others in their improvement of target words: F (2,58) = 4.36, $p < .05$.

Mechanics

The high-skilled pen and paper class showed the strongest editing of mechanics (10.8 of a possible 12) and sentence errors (1.5 of 2). This group also showed the lowest fluency (changing the original 127 words to a mean of 127.8), and the weakest holistic scores (5.1 on a 2 - 8 scale).

The fieldnotes illustrate the pattern of instruction leading to these results. Far more than her colleagues, Ms. Norris gave explicit lessons in editing. Rather than out-of-context grammar exercises, she taught students to correct their own writing--individually, and with peer partners. While such instruction occurred all year, the weeks just before the "Harry" task had been devoted to editing sample papers for mechanics, wordiness, and redundancy. These lessons were remembered.

I observed on the day of the "Harry" task that Ms. Norris, like the other teachers, began by reviewing the elements of a good story. Hands shot up. "Run-on sentences!" "Punctuation!" "Unnecessary words!" the children volunteered. "Yes," their teacher agreed, but then she explicitly reminded them of characterization, setting, plot, and word choice. "Change it any way you can to make a good story. . . . You are the editor."

Students set to work with orange pens and proofreading symbols, attacking the errors with concentration and authority. Ignoring their teacher's directions, they approached "Harry" just as they had many recent editing samples. Their response might have been different in October, after they created "Dear Dracula" letters of ghoulish advice. In February, however, the aspect of

"good writing" uppermost in their minds was correctness. Perhaps this emphasis distracted them from substantive revision, lowering holistic scores and fluency in an otherwise capable class.

Using the pretest as a covariant, Ms. Norris' group differed significantly from the others in their performance correcting surface errors: F (2,58) = 14.51, $p < .05$.

Teaching revision

Given the identical task and directions, four groups of students responded in three different patterns. Those patterns, in turn, can be traced to the instructional emphases of their teachers as documented in the fieldnotes. Effective writing teachers guide their students to see certain things--and to ignore others--when they revise.

How did the computer affect this process? The literature shows that most students--whether or not they use computers--do not know how to revise. When asked to improve a text, they aim for correcting mechanics, and often do a poor job of that.

For example, the National Assessment of Educational Progress (1977) found minimal revision among 9, 13, and 17 year olds. This study was based on handwritten texts from thousands of writers, generally with teachers untrained in the writing process.

The Harvard Microcomputer and Literacy Project (Michaels, Watson-Gegeo, & Cazden, 1985), a thorough ethnographic study, has reported similar results. The researchers expected increased revision and peer dialogue about writing in computer-equipped sixth grade classes--but found little of either. The teachers had minimal training in the writing process. Students wrote

first drafts by hand, teachers red-marked errors, and then students typed a corrected copy. Not surprisingly, few discovered that they could use the computer to reconstruct their writing.

In all four writing project groups in the present study, however, sixth graders revised. Not only did they revise, they revised in specific ways, following an internalized construct of "good writing."

The results of the "Harry" exercise suggest a number of points worthy of larger-scale research:

1. Revision for fluency, for word choice, and for correctness can be taught.
2. Instructional emphasis, not the presence or absence of computers, drives the revision process.
3. The computer is an asset to revision--when used with the guidance of a skilled writing teacher and when integrated with other writing tools in a learning environment based on the composing process.

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Footnotes

[1] The MILLIKEN WRITING WORKSHOP (1984) designed by Owen and Irene Thomas; COMPTRACE (1985) commissioned by the author and programmed by John Oberschelp with permission of Milliken.

[2] The error analysis was restricted to the planted flaws, and ignored any errors introduced when students revised and developed the story. Such new errors could affect the holistic scores.

[3] The 388 word "Harry" was written by a girl who joined the gifted center after the September pretest. It is not included in the data and does not bias the class means for fluency.

[4] Pretest was scored by project-trained teachers using the same procedures as "Harry" papers. Unadjusted scores, excluding anchors and rescores, have an intraclass correlation of .73.

[5] Group means favor the computer groups, but note the bias due to the unexpected performance of the large high-skilled pen and paper class:

Holistic scores: computer groups (n = 15)--6.067; pen/ paper groups (n = 46)--5.261. Using the pretest as a covariant, F (2,58) = 4.33, p < .05.

Fluency: computer groups--154.419 words; pen/ paper groups--129.130 words. F (2,58) = 4.45, p < .05.

[6] Just two of Ms. Zeller's students met the research sample criterion of regular instruction by a project teacher. "Harry" scores for all seven gifted: Mechanics = 9.929; Words = 3.714; Sentences = 1.143; Introduction/ conclusion = 1.143; Fluency = 178.142; Holistic = 6.857. Retesting for instructional emphasis, Zeller and Gill show F (2,63) = 5.67, p < .05.

Table 1

Mary's Error Analysis, Harry Task

	Mechanics	Word	Sentence	Intro/Conclusion
Possible Improvements	12	10	2	2
Mary's Improvements	9	5	2	1

Table 2

Bob's Error Analysis, Harry Task

	Mechanics	Word	Sentence	Intro/Conclusion
Possible Improvements	12	10	2	2
Bob's Improvements	2	1	1	0

Table 3

Patterns of Revision in Four Classes, Harry Task

	Class Means			
	Computer		Pen and Paper	
	Mixed	High	Mixed	High
Teacher	Quinn	Zeller	Gill	Norris
	(n = 13)	(n = 2)	(n = 21)	(n = 25)
Measures				
Pretest	5.923	10.000	6.333	7.040
(Range = 2-12)				
Error Analysis				
Mechanics	7.346	11.500	8.929	10.800
(N=12)				
Word Choice	2.039	4.000	2.857	2.020
(N=10)				
Sent. Str.	1.462	2.000	1.190	1.520
(N=2)				
Intro/Con.	.615	1.500	.571	.720
(N=2)				
Product				
Fluency	150.769	130.500	130.762	127.760
(Original = 127)				
Holistic	5.769	8.000	5.429	5.120
(Range = 2-8)				